

Influence of Technology Adoption on Credit Access among Small Holder Farmers: A Double-Hurdle Analysis

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Abstract

The proportion of bank lending to the agricultural sector is generally low across the globe, and the situation is no different in Kenya. This is despite the fact that commercial banks have continued to launch tailor-made loan products that target specific groups in the sector. Studies acknowledging low credit volume in the sector have mostly focused on supply side factors that account for the status. However, there are ex-ante factors averting potential agricultural clients from seeking commercial bank credit. This paper investigated mobile banking technology adoption as a factor influencing the level of agricultural credit demand by agricultural households. Using data from dairy farmers, the study explored the relationship between an individual's espousal of mobile banking technology and the likelihood to access a commercial bank loan through the mobile-banking platform. Specific social-demographic factors were hypothesized to moderate the relationship between mobile-banking technology adoption and credit access. The study was anchored on the fact that the world is swiftly transiting from an industrial to a knowledge-based technological environment for sustainable development. In line with this, commercial banks have been in the forefront in substituting traditional banking models with innovative technology based models in offering banking services including credit. An individual's espousal and frequency of use of mobile banking platform were used to assess a potential borrower's the level of technology adoption. Using the double-hurdle methodology, an assessment of the likelihood of participating in bank credit market using mobile technology services was analyzed using a normal Probit model. Then, a truncated Tobit model was used to evaluate the loan amount requested for, using data from respondents with positive credit amounts. Survey data was collected using a stratified random sampling from 243 households engaged in dairy farming within the study area. Findings revealed that technology adoption influence both the credit access, and the level of credit demand by dairy farmers from the commercial banks in the study area. Borrower's age and education level were found to moderate the relationship between technology adoption and credit access. The implication of the findings was that is that to increase loan volume, banks should put in place strategies to market all services on the mobile banking platform, including loan application. Further, the interventions should include targeted financial literacy programs with aspects of technological education among clients in the higher age brackets, as well as clients with low education status who reported low adoption.

Key words: Double-Hurdle, Sustainable, Credit, Access, Technology, Agriculture

1.0 Introduction

The world's sustainable development goals launched in 2016 for the 2030 agenda are expected to positively transform the livelihoods of people across the globe. The second sustainable development goal on

zero hunger addresses food security as a complex condition that requires a holistic approach by promoting sustainable agriculture. Research shows that the productivity of the agricultural sector is about four times more effective in reducing poverty than GDP from other sectors (World

Bank, 2013). This necessitates concerted efforts from different stakeholders in support of agriculture.

Specifically, there is a need for heavy investment capital and financial services for rural and agricultural activities. Data shows there is an annual financing gap of \$2-3 trillion per year in the current investment in SDG-related sectors. A high proportion of the financing gap is significant in agricultural related projects, alongside other critical areas (United Nations Development Programme, 2015). To support agriculture growth, a net investment of US\$83 billion is required of which US\$11 billion should be in sub-Saharan Africa (Alliance for a Green Revolution in Africa, 2015). This calls for purposeful increase in agricultural investment.

However, Agricultural Orientation Index (AOI) statistics shows global investment in agriculture by governments is low. The average global AOI fell from 0.38 in 2001 to 0.24 in 2013, and 0.21 in 2015 (UNDP, 2015). For the 2013-2015 period, AOI was highest in North America and Europe (0.39), followed by Western Asia and Northern Africa (0.38) and Eastern and South-eastern Asia (0.37); and lowest in Sub-Saharan Africa (0.17) and Latin America and the Caribbean at 0.15 (FAO, 2016).

Research shows that production efficiency levels are higher among producers who have access to formal credit, which is necessary for both short-term working capital and long term investment needs (Kibaara & Nyoro, 2007). Thus, credit enhances farm incomes through increased farm productivity and financing of modern farming technologies,

and is deemed an indispensable intermediating factor in production activities (Offiong et al., 2013; Christen & Anderson, 2013). Yet, rural households in developing countries lack adequate credit. Data on credit markets shows that approximately 2.5 billion people in the world lack access to credit financial services. Most of these people depend on agriculture either directly or indirectly for their livelihood (Baffoe & Matsuda, 2015).

One of the strategies adopted by Kenya government to address the financing challenge is the use of subsidized credit financing model administered through Agricultural Finance Corporation (AFC). By end of year 2016, AFC had managed to reach 72,960 clients out a target of 1,500,000 clients. This is a pointer to a huge financial intermediation deficiency in the agricultural sector in Kenya (AFC, 2016).

Commercial banks play an important role in financial intermediation. As custodians of deposits from households and firms with surplus resources, banks identify and select household and firms with financial deficits and on-lend these resources at a profit. However, despite the opportunities occasioned by the vast financial intermediation deficiency in Kenya's agricultural sector, commercial bank lending to agriculture in Kenya ranged between 3.0% and 3.7% between years 2010 and 2014. Further, only about 10% of smallholder farmers had access to commercial bank credit in the country (Nahr, 2014).

A credit decision principally involves both a borrower and a lender. Borrowers must create loan demand, while lenders enhance

financial inclusion by designing products and processes that match clients' needs. Since the end of the 20th century, the world economy has swiftly transited from an industrial economy towards a knowledge-based technology economic environment (Doss, 2006). Investment in technology and innovation is a strategic intangible resource. These play a fundamental role in value creation across all sectors, and interact with physical and human capital in contributing to a firm's performance (Chen, Danbolt, & Holland, 2014). Since all banks provide very similar financial intermediation services which are easy to replicate (Watkins, 2010). Therefore, intangible assets are fundamental in creating a competitive advantage for banks. Intangible assets are also useful in exploring markets that could enhance the bank's success.

In Kenya, digital-money platforms are broadly accepted. Many start-up businesses incorporate digital money transfer service as part of their entrepreneurial business models (Kendall, Schiff, & Smadja, 2014). Banks recognize the consumer trends and the central role of mobile phone in delivering technology driven services. Many commercial banks have forged partnerships with telecommunication companies to offer convenient customer financial services (Equity bank, 2010). Further, the banks persistently urge clients to utilize these mobile banking technological innovations. During the one year period to April 2017, the number of commercial bank loan applications increased by 23.4%, while loan volume decreased by about 18.3% in the same period. This suggests a growth in the small loan applications. A big proportion of

the smaller size loans were offered through the mobile phones. This is an indication that with the right environment, mobile phones can be the next main frontier for lending in the country (CBK, 2017).

The high cost of evaluating borrower creditworthiness is a major impediment to smallholder lending. Borrowers are not homogeneous and have adopted technology at different levels. The extent of technology adoption is deemed a significant factor in the interaction with the financial service provider. This interaction includes carrying out of basic banking functions such as processing deposits and withdrawals, payment of bills, fund transfers, account and loan application, and issuance of debit and credit cards.

Evaluation of technology based loan requests depend on borrower's interaction with the mobile banking technology. This study aimed at examining the relationship between a borrowers' adoption of mobile banking technology and access to commercial banks' credit in Kenya.

2.0 Literature review

Innovations are a powerful means for broadening and developing new markets, and can provide new functionality which in turn, disrupts existing market linkages (Christensen, 1997). A radical innovation introduces disruptive threats, which can be recognized by identifying the point of intersection between performance provided by a new technology and performance demanded by the existing consumers. The

disruptiveness of innovations is measured by the extent to which an emerging customer segment, and not the mainstream customer segment, sees value in the innovation at the time of introduction. This disrupts the products mainstream customers over time.

Initially, innovation attract an emerging or an insignificant, niche market. Where the innovations are offered at a lower price, they attract the more price-sensitive segments, and can have a major impact on an existing market (Pénicaud & Katakam, 2013). In modern times, technological innovations have emerged as a strategically important. This is because as a technology begins to address the needs of consumers in multiple market segments, the distinction between these segments is blurred, leading to radical changes in the existing practices.

Banking is an intellectually intensive sector, where both the financial resources and the intangible assets interact closely in the value creation process. The sector responds to the changes in the technological environment in the value addition processes (Chen, Danbolt, & Holland, 2014). In regions where financial inclusion is not optimal such as sub-Saharan Africa, the mobile financial services are strategic for individuals, mobile operators, financial institutions, technology firms, and governments (Kendall, Schiff, & Smadja, 2014).

A major challenge with regard to the distribution of financial services in the rural environment is the dispersion of the clients. This makes the unit costs of delivering the services higher in rural markets compared to the urban environments (Kombe & Wafula, 2015). Information technology innovations

such as wireless communication techniques, and cell phones are strategic tools for offering financial services to low-density populations. These services allow clients in various markets to access banking facilities from dispersed locations (Pénicaud & Katakam, 2013). The physical presence of banks in those markets is therefore not required for clients to interact with the banks. This provides a means for banks to efficiently serve the extended customer base, while simultaneously minimizing the need for expensive infrastructure (Kombe & Wafula, 2015).

Business models and systems for electronic banking are well tested in many markets around the globe. Electronic banking has a high potential market in Sub-Saharan Africa where over two-thirds of adults use mobile phones. In Kenya, mobile payment penetration is at 86 percent of households (Kendall, Schiff, & Smadja, 2014).

Most financial service providers have already ventured into electronic banking, which not only boosts banks' performance, but is also beneficial to the clients. Its use reduces transaction costs, save time, and increase customer convenience. Customers can instantly send payments from their mobile phones instead of traveling to distant bank branches. For the lenders, mobile phones create new credit scoring possibilities. A loan officer can access a loan applicant's mobile phone records of transactions with the bank, and combined with other data, can produce a credit decision to be shared with the applicant in minutes (Kumar & Muhota, 2012).

3.0 Materials and Method

Study area

The study targeted dairy farmers in Murang'a County, Central Kenya. The county's fiscal strategy paper (2016) cited inaccessibility to credit as a major factor contributing to low productivity in dairy sector (Murang'a County Government, 2016). At the time of the study, the area had seven commercial banks with a total of 18 operational branches. Four of the banks had loan products specifically targeting dairy farmers. The study area had over 255,696 households most of who were engaged in dairy farming at a subsistence level. These households were considered as potential clients for the commercial bank loan products.

The target population for the study were the over 100,000 registered dairy farmers within the study area. The accessible population was 21,576 dairy farmers who actively transacted business with thirty five dairy cooperative societies that were operational in the study area at the time of the study.

Stratified random sampling was used to select the borrowers' sample. The population was grouped in two strata, dairy cattle strata, and dairy goats' strata. Thereafter, a sampling fraction was used to derive a proportionate number of sampling units to ensure representativeness of the full population. Random probability sampling was then used to select participating respondents in each stratum (Berg, 2011).

Empirical Methodology

The study aimed at assessing the existing relationships between aspects of technology adoption and credit access. Given the

exploratory nature of the research, a cross sectional survey approach was used to collect household data. Questionnaires were administered to a sample of 243 household heads. The questionnaires comprised of closed ended questions to allow respondents to disclose information on personal finance while still upholding confidentiality. Counterfactual questions were also used to directly elicit respondents' status as either credit constrained or unconstrained, and assess the extent to which credit constrained respondents sought formal credit (Boucher, Guirking, and Trivelli, 2009).

A double hurdle model was used. Credit access was modeled to include first, a choice to be involved in commercial bank credit market (Participation); and second, the decision to request a specific loan amount (Consumption). The double-hurdle model provided a mechanism of accommodating all responses in the analysis. This included responses of zero level credit which occurred alongside positive levels of credit access (Varela & Dinar, 2017).

The first hurdle was a binary censoring of the likelihood of involvement. This incorporated data from all respondents in a normal probit model. Borrowers were assumed to display a latent utility derived from participating in commercial bank credit. The utility was assigned a value of 1 or 0 respectively depending on the choice.

Participating equation:

$$P = \beta X_i + U_i$$

$$P = \{1 \text{ if } P^*_i > 0; \text{ and } 0 \text{ if } P^*_i \leq 0\} \quad \text{Eqn 1(a)}$$

The borrower's labour quality, which was proxied by specified social-demographic

characteristics, was hypothesized to have a moderating effect both on the decision to participate in the credit market, and the loan amount requested for.

Moderated Participating equation:

$$P^*_i = \beta_i X_i \gamma_i + U_i;$$

$$P = \{1 \text{ if } P^*_i > 0; \text{ and } 0 \text{ if } P^*_i \leq 0\} \text{Eqn 1(b)}$$

The second hurdle concerned the loan amount. Once the borrower decided to actually use commercial bank credit, the next decision was the specific amount to consume/request for. This was estimated using a Truncated Tobit model, which only used data from respondents who actually reported a non- zero credit level.

Consumption equation:

$$Y = \beta X_i + \varepsilon_i; \quad \text{Eqn 2(a)}$$

Where:

P_i = Latent discrete involvement choice

Y_i = Observed amount of credit amount

B_i = Vector of parameters; to be estimated

X_i = Constructs assessing level of technology adoption

$\gamma_{i(i=1-5)}$ = Vector of moderating variables

U_i = Standard error term, normally distributed; $U_i \sim (0, 1)$

ε_i = Stochastic error term, normally distributed ; $\varepsilon_i \sim (0, \text{var})$

The error terms, U_i and ε_i were assumed to be independent, with a bivariate normal distribution as $U_i \sim N(0,1)$; and $\varepsilon_i \sim N(0, \sigma^2)$; such that the likelihood function of the double-hurdle model is equivalent to the sum of the likelihoods of the both the univariate probit model, and the truncated regression model (Varela & Dinar, 2017).

4.0 Results and Discussions

4.1 Response and Demographics

A total of 195 questionnaires were returned comprising 80.25% response rate. The data was first profiled in a summary as per gender, age, highest education level, farming experience, and distance from nearest commercial bank. Gender was included in the survey in order to establish if credit needs and access varied across gender. 55.4% of respondent households were male headed households while 44.6% were female-headed.

Respondents' age was grouped into four sub-categories. Age was used as a proxy for maturity (Awunyo et al, 2014). Findings indicated that the dairy sector was dominated by persons in the age bracket of between 30 - less than 50 years comprising 48.7% of the respondents. The 50 - less than 70 years age bracket comprised 32.8%. Only 10.3% of the respondents were less than 30 years, and while only 8.2% were above 70 years. This implied that, the majority of respondents were within the active working age groups.

The study found literacy levels amongst producers in the dairy sector in Kenya is high as 93.8% of the respondents had a formal education, and only 6.2 % did not have any formal education. The highest level of formal education acquired was further categorized into five sub-groups; primary, secondary, diploma/certificate, degree, and post graduate. Among those with formal education, 7.7% and 19.5% had a primary and secondary school certificate as the highest education qualification respectively. A majority of the respondents had either a diploma or a certificate education (47.7%);

while 22.5% had a bachelor's degree, and 2.6% had post graduate qualifications. This supported the research as majority of the respondents understood and responded to the questions in the research instrument with ease.

The research investigated respondent's farming experience. Preliminary studies indicated that commercial banks could provide credit facilities to dairy farmers who had at least six months farming experience. Findings indicated that respondents had considerable experience with 57.9% of the respondents having over 3 years' experience. 33.8 % had between 1-3 years of dairy farming experience. Only a cumulative 8.3% had less than one year experience.

The study also sought to model loan demand as function of distance to the nearest commercial bank. Findings revealed a high penetration of commercial banks in the study area. 18.5% and 60% of respondents accessed commercial banks within a radius of 10 and 20 kilometres respectively, 37.4% had access within a 30 kilometers radius. Only 2.6% of respondents had to travel for more than 30 kilometres to access a bank.

Table 4.1: Respondent's demographics

| Factor | Indicator | N | % |
|--------|----------------|-----|------|
| Gender | Male | 108 | 55.4 |
| | Female | 87 | 44.6 |
| Age | <30 years | 20 | 10.3 |
| | 30-<50 years | 95 | 48.7 |
| | 50- <70 years | 64 | 32.8 |
| | 70 yrs & above | 16 | 8.2 |

| | | | |
|------------|-----------------|-----|------|
| Education | Formal | 183 | 93.8 |
| | Informal | 12 | 6.2 |
| Educ.Level | Primary | 15 | 7.7 |
| | Secondary | 38 | 19.5 |
| | Cert / Diploma | 93 | 47.7 |
| | Degree | 44 | 22.5 |
| | Post graduate | 5 | 2.6 |
| Dairy Exp. | < 6 months | 4 | 2.1 |
| | 6 months - 1 yr | 12 | 6.2 |
| | 1-3 years | 66 | 33.8 |
| | > three yrs | 113 | 57.9 |
| Bank Dist | Less than 10 km | 36 | 18.5 |
| | 10-20 km | 81 | 41.5 |
| | 21-30 km | 73 | 37.4 |
| | Over 30 km | 5 | 2.6 |

A basic assumption of linear regression is the normal distribution of the dependent variable. Assessment of normality was first done using Shapiro-Wilk's W test, Results showed that the dependent variable, Credit access had a P-value of 0.992, which is greater than the selected 0.05 significance level. Thus, the null hypothesis that data represented a normally distributed population could not be rejected, leading to the conclusion that there was no significant departure from normality at the selected 0.05 significance level.

The level of technology adoption was hypothesized to influence credit access. An evaluation of access to mobile banking services was done by considering the penetration of the use of mobile phone technology in accessing banking services in the study area. The extent to which technology was embraced was assessed using two constructs; adoption, and

frequency of use of the mobile banking platform. Tolerance and Variance Inflation Factor (VIF) were used to check for possible collinearity between constructs. The test yielded a (VIF) = 1.865, meaning that the variance (imprecision) of the estimated coefficients was 1.865 times higher because of correlation between the two independent variables. A high VIF is a sign of multi collinearity. As a rule of the thumb, $VIF > 10$ is a sign of severe or multi-collinearity, $VIF > 5$ signifies high collinearity, while

$1 < VIF < 5$ signifies moderately correlated variables (Miles, 2014). Thus, a $VIF = 1.865$ was considered to be within acceptable range to facilitate a smooth the progress of the research.

Findings revealed that despite a high mobile-payment penetration at 86% of households in Kenya (Okiro & Ndung'u, 2013); use of the basic mobile banking facilities was low amongst respondents.

Table 4.2: Use of mobile -banking services

| | 1 | 2 | 3 | 4 | 5 | Total |
|------------------------------------------------------|------|------|------|------|-----|-------|
| | % | % | % | % | % | % |
| Loan enquiry | 81.6 | 10.9 | 4.5 | 1.0 | 2.0 | 100.0 |
| Loan Application | 84.6 | 12.9 | 1.5 | 1.0 | 0.0 | 100.0 |
| Loan Repayment | 45.5 | 8.5 | 30.0 | 16.0 | 0.0 | 100.0 |
| Savings deposits | 14.5 | 2.0 | 22.5 | 51.5 | 9.5 | 100.0 |
| Pay Insurance | 70.0 | 2.5 | 10.5 | 15.5 | 1.5 | 100.0 |
| 1=Never; 2= Rarely; 3= Often; 4=Very often; 5=Always | | | | | | |

Only 13.4% and 11.4 % of respondents had ever used their mobile phones for loan application and loan repayment respectively. Transfer of funds of personal savings to the banks using the mobile banking platform had gained a wide acceptance with 83.6% of the respondents having used the service more than once. However, an assessment of

the frequency of use of the various services also revealed that the frequency of the adoption of basic mobile banking technology was not steady. In all cases, only less than 10% of the respondents always used any of the facilities, suggesting a non holistic adoption of technology. (Table 4.2)

4.3 Hypothesis Testing

The relationship between technology adoption and credit access was assessed at the two levels. First, an investigation on the likelihood to participate in commercial bank credit was done using a probit model. The Chi square results of the normal probit model statistics 25.38 (p-value 0.001 < 0.05)

indicate that the model is statistically significant (Table 4.3) implying that technology adoption was a significant variable in explaining the likelihood of credit access. The value of R^2 showed that a borrowers' use of technology adoption explained 24.2% of the likelihood of credit access. The findings resonate with Kombe

and Wafula (2015) who affirm that a customers' ICT competence improves the performance of a bank through increased

likelihood of extended client base as a result of internet banking.

Table 4.3 Technology adoption Probit Model Fit

| Statistic | Obs(n) | LR chi2(4) | Prob> chi2 | Pseudo R2 | Log likelihood |
|-----------|--------|---------------|---------------|-----------|----------------|
| Value | 195 | 25.38 | 0.001 | 0.242 | -39.73870 |

The significance of the constructs of technology adoption was analyzed using the Z- score. Findings reveal that use of mobile phone platform services (Z= 0.98; p- value=0.327) does not on its own was not significant in predicting the decision to seek a credit

product from a commercial bank (Table 4.4). The results however depict frequency use of mobile banking facilities as statistically significant in predicting the likelihood of credit access from a commercial bank (Z=1.97; p-value =0.048).

Table 4.4 Coefficient table: Technology Adoption and Credit Access

| CreditAP | Coef. | Z | P>z |
|----------|----------|-------|-------|
| USE | 0.476345 | 0.98 | 0.327 |
| FREQ | 0.572077 | 1.97 | 0.048 |
| _cons | -1.13559 | -2.17 | 0.03 |

The relationship between the frequency of technology adoption and the likelihood of credit access (CA) is therefore represented in the Participation equation (P)

$$P = -1.13559 + 0.572077_{FREQUENCY} + \dots$$

The quantification of the influence of frequency of technology adoption on the

likelihood of credit access was analyzed, by their marginal effects. Whereas Use was not significant on its own(Z= -1.2, P value = 0.234), the study found that a one unit increase in frequency of use of services available on mobile banking platform increased the likelihood of accessing credit from Sh 1,000 to sh 1,422.07.

Table 4.5 Marginal effects for technology adoption on credit access

| | dy/dx | Z | P>z |
|------|----------|------|-------|
| USE | -2887.41 | -1.2 | 0.234 |
| FREQ | 1422.07 | 2.11 | 0.036 |

At the second hurdle, an investigation into the relationship between technology adoption and the credit amount requested from the bank was done. All respondents who reported a zero credit access were excluded, and the analysis was based on information gathered from individuals who had serviced at least one loan from a commercial bank. A truncated Tobit model was used for the analysis. All the slope coefficients were found to be jointly significant at 5% significance level (p-value $0.0024 < 0.05$).

Wald test was used to find out if the explanatory variables in the model were significant. The test yielded a non- Zero parameter at 14.38, signifying that the included variables and the model was a good

fit at 95% confidence interval (Greene, 2012). The Tobit model regression results (Table 4.6) shows the quantification of the credit amount attributable to technology adoption. Variables with P-values less than 0.05 suggest that the corresponding coefficients are statistically significant (Gonzalez, 2016). This implied that at 95% confidence interval, an increase in the frequency of use of services on the mobile banking platform results in an increase in the loan amount of 55.47%. Thus, Loan Amount(Y) was represented by the equation:

$$\text{Loan Amount} = 0.5547_{\text{FREQ}} + \square\square\square$$

The constant term is omitted in expressing the equation as the corresponding Z-score value is less than 1.96 hence insignificant.

Table 4.6 Technology Adoption Tobit model regression results

| CreditAP | Coef. | Z | P>z |
|----------|-----------|-------|-------|
| USE | -1126.335 | -1.92 | 0.055 |
| FRQAD | 0.554729 | 2.05 | 0.001 |
| _cons | -120.718 | -1 | 0.318 |

Moderating effect of labour quality on relationship between technology and credit access

Moderation occurs when a moderating variable M, causes an alteration, by either enhancing, or weakening the relationship between an independent and a dependent variable. To verify the role of the moderator, the difference in pseudo R^2 was considered (Kamel & Lloyd, 2015). Change in R^2 is a measure of the increase in the predictive power of particular dependent variable,

given the dependent variable or variables already in the model (Studenmund, 2011). In testing the hypothesis on the moderating effect of labour quality on the likelihood to participate in commercial bank credit market, probit regression model was used. The proxies of the interaction terms were added into the model to examine the interaction with each of the proxies for labour quality. Consistent with Olagunju & Ajiboye (2010), Age and Education level had a significant moderating effect, while

Gender, Experience and Distance were insignificant (Table 4.7).

Table 4.7 Moderating effect of social demographic characteristics

| | | Gender | Age | Education | Experience | Distance |
|----------------|-----------|-----------------------|------------------------|-----------------------|-----------------------|-----------------------|
| Technology Use | Probit | 0.383437; Z= 0.73 | 4.443942; Z= -2.02* | 0.25537; Z= 1.98* | -0.05325; Z= -0.11 | -0.30457; Z= -0.95 |
| | Truncated | -0.166097; | 14.007; | 22.52259; | | -0.36792; |
| | tobit | Z= -0.13 | Z= 0.19 | Z= 1.99* | | Z= -1.87 |
| Frequency | Probit | -0.35834; Z= -0.87 | 0.509591; Z= 1.99 * | -0.00034; Z= 2.06* | 0.593121; Z= 2.23* | 0.400707; Z= 1.98* |
| | Truncated | 10.65050; | 9.990216; | 40.71715; | 20.01597; | 166.2500; |
| | tobit | Z= 0.5 | Z= 0.64 | Z= 1.97* | Z= 0.18 | Z= 0.92 |

**Significant at 5% level of significance*

The MC Fadden R-square (R^2) =0.3085 in the probit model signify that AGE (Z -score = - 2.02) had a significant moderating effect on the relationship between the use of mobile banking technology and credit access. This means that interaction of technology with AGE resulted in a 30.85 % variance in the likelihood to use technology based platforms. Interaction between age and frequency of use of services on the mobile banking platform revealed there was a statistically significant explanation of a higher likelihood of seeking credit through the mobile platform from increased frequency of use of the mobile banking services (Z= 1.99), The MC Fadden R-square result meant that an increase in frequency of use, which was differentiated at different age brackets resulted in a 30.19% increase in the likelihood of the users to seek credit through the mobile technology platform (Table 4.8).

Inclusion of the moderation term education level (EDU) improved the estimation in the Probit model (p-value<0.05) and Tobit

models (p-value 0.0685<0.05). Results revealed that EDU (Z-score=1.98) had a significant moderating effect on the relationship between the use of mobile banking technology and credit access. The MC Fadden R-square result implied that interaction of technology with EDU explained 10.12% variance in the likelihood to use technology based platforms. Results of the second hurdle in the moderated truncated Tobit model revealed that EDU was statistically significant (Z=1.99) in influencing the relationship between the use of technology and the loan amount requested for through use of mobile technology platform (Table 4.6). This implied the higher the respondent's education level; the more likely they were to utilize mobile banking technology services compared to less educated counterparts. Erasto (2014) posit that at higher levels of education, respondents are able to seek, receive and understand technology.

Results of the interaction between EDU and the frequency of use of mobile banking services revealed similar results. Both Probit (p-value $0.000 < 0.05$) and Tobit models (p-value $0.0115 < 0.05$) fitted better with EDU as a moderating variable. There was a statistically significant relationship between a high frequency of use of the mobile

banking services and the likelihood of seeking commercial bank credit through the mobile platform ($Z = 2.06$). The R^2 result of 0.1811 meant that an increase in frequency of use, which was differentiated at different education levels resulted in a 18.11% variance in the likelihood of seeking credit through the mobile technology platform.

Table 4.8 Moderated Probit Regression results

| | | Prob > chi2 | LR chi2(3) | Pseudo R ² |
|------------|-----------|-------------|------------|-----------------------|
| Gender | Use | 0.000 | 16.75 | 0.075 |
| | Frequency | 0.000 | 39.8 | 0.1787 |
| Age | Use | 0.034 | 68.87 | 0.3085 |
| | Frequency | 0.011 | 67.24 | 0.3019 |
| Education | Use | 0.000 | 22.59 | 0.1012 |
| | Frequency | 0.026 | 40.34 | 0.1811 |
| Experience | Use | 0.001 | 16.32 | 0.0731 |
| | Frequency | 0.000 | 45.65 | 0.205 |
| Distance | Use | 0.0006 | 17.36 | 0.0778 |
| | Frequency | 0.000 | 45.21 | 0.203 |

The second hurdle used the Wald chi-squared test to find out if the labour quality proxies are significant in moderating the relationship between technology adoption and the loan amount. Variables with p values < 0.05 suggest that the corresponding coefficients are statistically significant in explaining the loan amount requested to finance dairy farming operations. Education was found to be significant in moderating the relationship between both the use (p-

value = 0.0455) and the frequency (p value = 0.0115); and the loan amount requested for (Table 4.9). The findings were interpreted to mean that at higher education levels, there was a greater use and more demand of loans through the mobile banking platform. This can be explained by the possibility of alternative employment that enhanced repayment ability, as well as a greater appreciation of the convenience accorded by the mobile banking platform.

Table 4.9 Moderated Truncated Tobit Regression results

| | | ˆ Prob > chi2 | Wald chi2(3) |
|--------|------|---------------|--------------|
| Gender | Use | 0.9807 | 0.18 |
| | Freq | 0.5984 | 1.88 |
| Age | Use | 0.9981 | 0.04 |

| | | | |
|------------|------|--------|-------|
| Education | Freq | 0.7765 | 1.1 |
| | Use | 0.0455 | 9.49 |
| Experience | Freq | 0.0115 | 11.04 |
| | Use | - | - |
| Distance | Freq | 0.6313 | 1.73 |
| | Use | 0.5563 | 1.86 |
| | Freq | 0.7275 | 1.31 |

5.0 Conclusion

The banking industry has been in the forefront in substituting traditional banking models with innovative technology based models for offering banking services including credit (Kendall, Schiff, & Smadja, (2014). This is in the view of the exponential growth and permeation of technology in all sectors. Most commercial banks have mobile technology applications which deliver value and convenience to both the bank as well as the clients.

Using a comprehensive data from Murang'a county Central Kenya, an area which demonstrated purposeful support of dairy farming, the study found that mobile banking technology services had been well embraced in the dairy sector. Commercial banks had loan products purposefully tailored for dairy sector. As well, the farmers who were largely drawn from the rural farming households transacted on mobile banking platform substantially for balance enquiries, and to a considerable extent for deposits and bank transfers.

The findings of the study revealed that age and education level influenced both the

espousal, and the frequency of use of mobile banking technology to access credit. As a result, credit access through the mobile banking platform depicted an increasing trend as age and education attainment increased. However, the study revealed that gender and distance from bank did not moderate the relationship between technology adoption and credit access. A unique finding was that even where the use of mobile banking services was robust, loan application rarely used mobile banking services.

An important conclusion from the study was that commercial banks should pay special attention by modeling their marketing strategies to popularize all the services, especially the loan application service which was available on the mobile banking platform. Further, banks keen on expanding client's reach through the mobile banking platform to achieve a higher transition to the technology platform should include deliberate efforts to popularize all the mobile banking services among clients in the higher age brackets, as well as clients at low education status. This may include implementing adult technology literacy programmes.

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